

Disclaimer:

This English translation is produced by machine translation and may contain errors. The JPO, the INPIT, and those who drafted this document in the original language are not responsible for the result of the translation

Notes:

1. Untranslatable words are replaced with asterisks (\*\* \*\*).
2. Texts in the figures are not translated and shown as it is

Translated: 07:06:43 JST 12/31/2008

Dictionary: Last updated 12/10/2008 / Priority: 1. Chemistry / 2. Natural sciences / 3. Nuclear

---

## FULL CONTENTS

---

### [Claim(s)]

[Claim 1] [ No. 3 silicate of soda / what carried out 3-30 weight part addition of the way acid as an additive to the solid content 100 weight part ] Specific gravity (Msn-Mt)/for the No. 3 silicate of soda calculated by a bottom formula at 160-300 degrees C in a foaming container in the gel-like raw material evaporated until it heated and a moisture content became 70 - 80 weight part to the solid content 100 weight part of No. 3 silicate of soda, agitating beforehand (Vx1000)

Here V: Volume of the produced foam (m3)

Weight of the foam Msn(ed) : produced (kg)

Mt: Weight of the additive before foaming (kg)

The production method of the core material for metal sandwich panels characterized by carrying out heating foaming so that it may become \*\* 0.1-0.9.

[Claim 2] [ No. 3 silicate of soda / what carried out 10-100 weight part addition of the hydroxylation aluminum as an additive to the solid content 100 weight part ] Specific gravity (Msn-Mt)/for the No. 3 silicate of soda calculated by a bottom formula at 160-210 degrees C in a foaming container in the gel-like raw material evaporated until it heated and a moisture content became 70 - 80 weight part to the solid content 100 weight part of No. 3 silicate of soda, agitating beforehand (Vx1000)

Here V: Volume of the produced foam (m3)

Weight of the foam Msn(ed) : produced (kg)

Mt: Weight of the additive before foaming (kg)

The production method of the core material for metal sandwich panels characterized by carrying out heating foaming so that it may become \*\* 0.1-0.9.

[Claim 3] [ No. 3 silicate of soda / what carried out 10-100 weight part addition of 3 - 30 weight part and the hydroxylation aluminum for the way acid as an additive to the solid content 100 weight part ] Specific gravity (Msn-Mt)/for the No. 3 silicate of soda calculated by a bottom formula at 160-210 degrees C in a foaming container in the gel-like raw material evaporated until it heated and a moisture content became 70 - 80 weight part to the solid content 100 weight part of No. 3 silicate of soda, agitating beforehand (Vx1000)

Here V: Volume of the produced foam (m3)

Weight of the foam Msn(ed) : produced (kg)

Mt: Weight of the additive before foaming (kg)

The production method of the core material for metal sandwich panels characterized by carrying out heating foaming so that it may become \*\* 0.1-0.9.

---

### [Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the production method of the core material for metal sandwich panels which is the minerals system which uses silicate of soda as a foaming raw material, and consists of lightweight foam used as a core material of the structural panel equipped with fire prevention and fire resistance, especially the metal sandwich panel which covered the metal plate to both sides.

[0002]

[Description of the Prior Art] Conventionally, as a panel which has fire prevention and fire resistance, much technology is indicated, for example, use a minerals lightweight aggregate as a main raw material at JP,H8-192491, A, and let thermosetting synthetic resin of a non-foamed type etc. be a binder. The fire-resistant panel which the used sandwich panel adds various minerals material to the surface of synthetic resin foam or its inside at JP,S53-104681,A, and forms in one is indicated. Moreover, the panel filled up with the core material by which the intermediate part was constituted from an inorganic fiber aggregate, and both ends were constituted from inorganic hardening material between the metal envelopes of two sheets, and its production method are indicated by JP,H8-80591,A.

[0003] Moreover, in JP,S56-88865,A, it is a minerals binder as a thing using water glass. [ the lightweight foam which applies low-melting-glass powder or glaze to the surface, heats again, and is manufactured after adding and carrying out high-frequency heating of a lot of foaming inorganic particles to the kneaded material of \*\* silicate impalpable powder and a silicic acid alkaline water solution ] [ the insulative object the grade to which minerals foam is kneaded with water glass as a minerals binder to JP,S47-30716,A, and water glass does not foam was made to heat ] The minerals Plastic solid which made the minerals material of the particulate matter add and harden metal silicon etc. as a binder as a silicic acid alkali, caustic alkali of sodium, and a hardening assistant is proposed by JP, H6-48808,A.

[0004] However, in addition, there is a problem in these Prior arts. That is, it is in the core material of the panel currently indicated by JP,H8-192491,A and JP,S53-104681,A, Since a lot of synthetic resins are contained, it is not only inferior to fire resistance, but compared with minerals material, an environmental problem in recent years may receive restrictions of a regulation system, and there is a possibility that a product unit price may become expensive for this correspondence. On the other hand, since the panel currently indicated by JP,H8-80591,A consists of only minerals material, there is no environmental problem, and the weight saving is attained, but since a complicated manufacturing process is needed, there is a fault which becomes expensive [ a product unit price ].

[0005] Moreover, lightweight foam currently indicated by JP,S56-88865,A, Since the operation which adds and kneads a silicic acid alkaline water solution to silicate impalpable powder, and the operation which adds foaming inorganic particles, such as perlite, so much to this kneaded material, and kneads them further to it are required since work adds and kneads a lot of foaming inorganic particles difficult -- powder -- a henchman -- [ be / a possibility that nonuniformity may be made to cloth and homogeneity may be missing ] Since it is necessary to apply the powder or glaze of low melting glass to the surface of the foaming hardened material obtained by having carried out high-frequency heating, and to carry out for [ 10 minutes ] grade calcination at 500-800 degrees C again in order to give a water resisting property, there is a fault which becomes expensive [ a product unit price ]. The insulative object currently indicated by JP,S47-30716,A, Since water glass as a minerals binder is not made to foam, a weight saving cannot be attained. Since loadings of inorganic foam must be increased in order to attain a weight saving, when mixed nonuniformity is produced that it is easy to produce the bias of inorganic foam and it is made a panel, there is a possibility that hardness and firesafety may become uneven. Moreover, the minerals Plastic solid currently indicated by JP,H6-48808,A, [ since it consists of only minerals material, excel in fire resistance and there is also hardness, but ] Since the silicic acid alkali, the caustic alkali of sodium, and the hardening assistant as a minerals binder as well as the insulative object currently indicated by said JP,S47-30716,A are not made to foam, a weight saving cannot be attained. Since loadings, such as perlite which is the minerals material of a particulate matter, must be increased in order to attain a weight saving, when mixed nonuniformity is produced that it is easy to produce the bias of the minerals material of a particulate matter and it is made a panel, there is a possibility that hardness and firesafety may become uneven.

[0006]

[Problem(s) to be Solved by the Invention] This invention is lightweight foam which cancels the fault of the above mentioned core material for panels of the \*\*\*\* former, and uses the silicate of soda as a charge of non-equipments as a foaming raw material. Let it be a technical problem to offer the method of manufacturing simply the existing core material for panels of the insulation properties and fire resistance which can manufacture the panel which has the same fire prevention and fire-resistant performance as usual only by intercalating between the metal envelopes of the front reverse side.

[0007]

[Means for Solving the Problem] [ this invention person / without using an inorganic particle like perlite to which it foamed beforehand, as a result of inquiring wholeheartedly that said technical problem should be solved ] As a result of meaning carrying out foaming hardening of the charge of non-equipments with heating, and using the whole as uniform foam, as a charge of non-equipments, use No. 3 silicate of soda as a foaming raw material, and to the solid content 100 weight part as an additive [ what carried out 10-100 weight part addition of 3 - 30 weight part and/or the hydroxylation aluminum for the way acid ] About the gel-like raw material evaporated until it heated and a moisture content became 70 - 80 weight part to the solid content 100 weight part of No. 3 silicate of soda, agitating beforehand, the additive of a case is 160-300 degrees C only a way acid in a foaming container. In the case of others, it is specific gravity (Msn-Mt)/for the No. 3 silicate of soda calculated by a bottom formula at 160-210 degrees C ( $V \times 1000$ ).

Here V: Volume of the produced foam (m3)

Weight of the foam Msn(ed) : produced (kg)

Mt: Weight of the additive before foaming (kg)

When carrying out heating foaming so that it might become \*\* 0.1-0.9, it studied that the core material by which the water resisting property was improved when a way acid was added as an additive, and fire resistance was further improved when hydroxylation aluminum was added as an additive was obtained, and this invention was completed.

[0008] Silicate of soda is specified to JISK1408, as shown in Table 1.

[0009]

[Table 1]

J I S K 1 4 0 8

項目	種類		
	1号	2号	3号
外観	水あめ状の無色ないわずかに着色した液体		
ボ－メ比重(15℃)	—	5.4以上	4.0以上
二酸化珪素(SiO <sub>2</sub> )%	35～38	34～36	28～30
酸化ナトリウム(Na <sub>2</sub> O)%	17～19	14～15	9～10
鉄(Fe)%	0.03以下	0.03以下	0.02以下
水不溶分%	0.2以下	0.2以下	0.2以下

[0010] In addition, it is if specific gravity is the Baume specific gravity in the above-mentioned table and the Baume specific gravity 40 of No. 3 silicate of soda is converted into the usual specific gravity.

144.3

比重＝                    

144.3－ボ－メ度

It comes out and is set to 1.38. Moreover, in the sum of SiO<sub>2</sub> and Na<sub>2</sub>O, the solid content content is about 40%, and

moisture is about 60%.

[0011] As silicate of soda to be used, the foam with which the foam which used No. 1 silicate of soda and No. 2 silicate of soda as the raw material used [ as opposed to / each / the thing with low hardness ] No. 3 silicate of soda as the raw material has sufficient hardness, and adopts No. 3 silicate of soda from the result of the preliminary test that the water resisting property is also most excellent.

[0012] Furthermore, water was made to immerse a way acid, way sand, and the foam that used as the raw material what carried out 3 weight part addition of the sodium fluorosilicate, respectively to the foam and the No. 3 silicate-of-soda solid content 100 weight part which used only No. 3 silicate of soda as the raw material as a preliminary test, and the waterproof test was done. As a result, only in the case of No. 3 silicate of soda, it was one day, and to beginning to collapse in six days, when way sand is added, when a way acid or sodium fluorosilicate was added, even if one week passed, it turned out that form is held. However, since the specific fluoride to generate has toxicity when sodium fluorosilicate is added, it is not desirable. It adds a way acid, when you need a water resisting property from this result. Moreover, in order to raise fire prevention and fire-resistant performance, the substance which will decompose if it becomes high temperature including water of crystallization, and is made to generate water is added. Although hydroxylation aluminum, water gypsum fibrous, etc. are generally known as a substance containing water of crystallization, hydroxylation aluminum is excellent if the moisture burst size per unit weight is taken into consideration.

[0013] If heating operation is performed to what added the way acid and the additive of hydroxylation aluminum to No. 3 silicate of soda or this, the moisture in No. 3 silicate of soda will serve as a steam, and will evaporate, No. 3 silicate of soda will solidify with dilation, and foam will be obtained. Under the present circumstances, if it puts in a container and heats, since the volume of foam changes with the inner capacity of a container, it can obtain the foam of various specific gravity. In this case, even if it fixes quantity of a raw material and changes the inner capacity of a container, inner capacity of a container may be fixed and the quantity of a raw material may be changed.

[0014] The specific gravity of the heating foam of the silicate of soda which added a way acid and hydroxylation aluminum is called for by the following formula as specific gravity for No. 3 silicate of soda, and it is made for the figure to be set to 0.1-0.9.

Specific gravity  $= (\text{Msn} - \text{Mt}) / \text{for No. 3 silicate of soda} (V \times 1000)$

Here V: Volume of the produced foam (m3)

Weight of the foam Msn(ed) : produced (kg)

Mt: Weight of the additive before foaming (kg)

Since the foam whose value of this is smaller than 0.1 will become heavier than inorganic combustion boats, such as plaster board, if it becomes larger than 0.9 unproducible, it becomes disadvantageous in respect of construction.

[0015] Since after heating foaming will not change the  $(\text{SiO}_2) / (\text{Na}_2\text{O})$  ratio if No. 3 silicate of soda is used as silicate of soda, the molar ratio is 2.80-3.33.

[0016] As No. 3 silicate of soda was shown in said table 1, since 28 - 30 weight part and  $\text{Na}_2\text{O}$  is 9 to 10 weight %, solid content is 37 to 40 weight %, a moisture content is 60 to 63 weight %, and  $\text{SiO}_2$  are the liquid of the shape of a starch sirup of colorlessness or light color. It is made to evaporate until it heats what added and carried out mixed malaxation of the additives, such as a way acid and hydroxylation aluminum, to this No. 3 silicate of soda, agitating beforehand and a moisture content becomes 70 - 80 weight part to a No. 3 silicate-of-soda solid content 100 weight part, and a gel-like sample is produced. Since this operation interrupts heating for the state where moisture still remains, foaming is not produced in No. 3 silicate of soda. It will harden, if a moisture content becomes less than 70 weight parts to a No. 3 silicate-of-soda solid content 100 weight part, and it stops foaming. Moreover, when a moisture content exceeds 80 weight parts to a No. 3 silicate-of-soda solid content 100 weight part, it is as [ solution form ]. Since inorganic foam with a possibility that it may be ground during kneading like perlite is not being used for the raw material used for such foam It is not necessary to use the special kneading means which prevents grinding, and the usual kneading machine can be used, and even if a gel-like sample does not use a container, it can be carried by hand and is easy handling. The sample of the shape of this gel is paid in a foaming container,

according to a microwave etc., only in the case of a way acid, an additive heats at 160-300 degrees C, in the case of others, heats at 160-210 degrees C, and heating foam is obtained. This is because a way acid changes to the anhydrous one acid and is not desirable in respect of about [ that a water resisting property falls ] or thermal efficiency, if decomposition of hydroxylation aluminum will begin to be performed if sufficient foaming hardening and the sufficient scupper of No. 3 silicate of soda are not performed at less than 160 degrees C but cooking temperature exceeds 210 degrees C, and it exceeds 300 degrees C.

[0017]

[Embodiment of the Invention] A work example explains this invention hereafter.

[0018]

[Example] It is an additive to the solid content 100 weight part to 40 weight % of work-example 1 solid content, and the No. 3 silicate of soda of 60 weight % (namely, receiving a solid content 100 weight part moisture content 150 weight part) of moisture contents. The way acid was heated agitating beforehand additive-free, 3, 5, 10, 15 and 30, and the thing that carried out 35 weight part addition, the half of moisture was evaporated, and the sample of the shape of a gel of a moisture content 75 weight part was produced to the silicate-of-soda solid content 100 weight part. It supplies in the foaming container which adjusts input for this sample and has fixed content volume, While heating at about 170 degrees C according to a microwave with a frequency of 2450MHz and carrying out foaming hardening uniformly, moisture was evaporated nearly completely, and the specific gravity for the No. 3 silicate of soda called for by said formula (Msn-Mt)/(Vx1000) manufactured 0.1, 0.5, and the foam set to 0.9. The result of having measured a foaming situation and the waterproof time by boil water immersion about these foam is shown in Table 2.

[0019]

[Table 2]

サンプルNo.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
比重	0.1	0.5	0.9	0.1	0.5	0.9	0.1	0.5	0.9	0.1	0.5	0.9	0.1	0.5	0.9	0.1	0.5	0.9	0.1	0.5	0.9
発泡倍率	25	5	8	26	5	3	27	6	4	29	6	3	31	6	4	37	7	4	38	8	5
ほう酸	0	0	0	3	3	3	5	5	5	10	10	10	15	15	15	30	30	30	35	35	35
発泡状況	良好	良好	良好	良好	良好	良好	良好	良好	良好	良好	良好	良好	良好	良好	良好	良好	良好	良好	不良	不良	不良
耐水時間(分)	3	4	7	8	8	10	10	10	12	17	18	21	60	60	60	60	60	60	—	—	—

比重は3号珪酸ソーダ分の比重、耐水時間における60は60分以上であることを示す。

[0020] Except the sample which carried out 35 weight part addition not having foamed in a way acid enough, and were not able to fabricate it, the foaming situation was all good. Although the sample which did not add a way acid is several minutes and 3 weight parts and the sample which carried out 5 weight part addition began to melt in about 10 minutes about a water resisting property, the sample, as for, more than 15 weight parts added the way acid was changeless also in immersion of 1 hour. therefore -- the loadings of the way acid which raises a water resisting property receives a No. 3 silicate-of-soda solid content 100 weight part -- 3 - 30 weight part -- it is 15 - 30 weight part preferably. Although a metal sandwich panel is used as objects for interiors, such as objects for the exterior, such as an outer wall of a building, and a roof, a partition, and an inner wall, As for the metal sandwich panel used as an object for the exterior, it is desirable to use as a core material what carried out 15-30 weight part addition of the way acid to the No. 3 silicate-of-soda solid content 100 weight part since it was desirable to have sufficient water resisting property. Since it is unnecessary to have sufficient water resisting property, as for the metal sandwich panel used as an object for interiors, it is possible for what carried out 3-15 weight part addition to use a way acid as a core material to a No. 3 silicate-of-soda solid content 100 weight part.

[0021] It is an additive to the solid content 100 weight part to 40 weight % of work-example 2 solid content, and the No. 3 silicate of soda of 60 weight % (namely, receiving a solid content 100 weight part moisture content 150

weight part) of moisture contents. Hydroxylation aluminum was heated agitating beforehand 7, 10, 35, and the thing that carried out 50,100,110 weight part addition, the half of moisture was evaporated, and the sample of the shape of a gel of 75 weight % of moisture contents was produced to the silicate-of-soda solid content 100 weight part. It supplies in the foaming container which adjusts input for this sample and has fixed content volume, [ while heating at about 170 degrees C according to a microwave as well as a work example 1 and carrying out foaming hardening uniformly, the specific gravity for the No. 3 silicate of soda which moisture is evaporated nearly completely and called for by said formula (Msn-Mt)/(Vx1000) manufactured 0.1, 0.5, and the foam set to 0.9, but ] Since hydroxylation aluminum formed lumps and what carried out 110 weight part addition of the hydroxylation aluminum to the solid content 100 weight part of No. 3 silicate of soda could not be mixed well, good foam was not able to be manufactured, but each was able to be fabricated except it. The result of having measured the foaming situation about these foam is shown in Table 3. Moreover, the specific gravity for the above-mentioned No. 3 silicate of soda is urethane resin adhesives at 200g/m<sup>2</sup> of one side to both sides of the sample of 50mm thickness about the foam of 0.1. What applied and pasted up the color steel plate of 0.5mm thickness is put into an electric furnace, bulk temperature is raised along with the master curve of ISO834, and the fireproof test result which measured the back temperature of 0, 5, 10, 15, 20, 25, and 30 minutes after, respectively is shown in Table 4. [0022]

[Table 3]

サンプル№	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
比重	0.1	0.5	0.9	0.1	0.5	0.9	0.1	0.5	0.9	0.1	0.5	0.9	0.1	0.5	0.9	0.1	0.5	0.9
発泡倍率	25	5	3	25	5	3	25	5	3	25	5	3	25	5	3	25	5	3
水酸化アルミ	7	7	7	10	10	10	35	35	35	50	50	50	100	100	100	110	110	110
発泡状況	良好	良好	良好	良好	良好	良好	良好	良好	良好	良好	良好	良好	良好	良好	良好	不良	不良	不良

比重は3号珪酸ソーダ分の比重を示す。

[0023]

[Table 4]

水酸化アルミ 添加量(重量部)	時間(分)						
	0	5	10	15	20	25	30
7	35	45	85	90	150	230	320
10	35	45	85	90	140	200	270
35	35	40	80	90	95	140	220
50	35	40	80	85	90	95	120
100	35	40	75	85	90	90	90

裏面温度(℃)

[0024] As a result, although each sample currently manufactured as foam burned or it did not collapse, receive a No. 3 silicate-of-soda solid content 100 weight part. By the sample which more than 10 weight parts added compared with the sample which carried out 7 weight part addition of the hydroxylation aluminum, the temperature of the back of 30 minutes after fell, so that the loadings of hydroxylation aluminum was large. Therefore, as for the loadings of hydroxylation aluminum, more than 10 weight parts need below 100 weight parts to raise the fire resistance of foam.

[0025] It is an additive to the solid content 100 weight part to 40 weight % of work-example 3 solid content, and the

No. 3 silicate of soda of 60 weight % (namely, receiving a solid content 100 weight part moisture content 150 weight part) of moisture contents. It heated, the half of moisture was evaporated, having agitated 15 and 30 weight parts for the way acid, and agitating beforehand 7, 10, 35, and the thing that carried out 50,100 weight part addition for hydroxylation aluminum, and the sample of the shape of a gel of 75 weight % of moisture contents was produced to the silicate-of-soda solid content 100 weight part. While supplying in the foaming container which adjusts input for this sample and has fixed content volume, heating according to a microwave as well as a work example 1 and carrying out foaming hardening uniformly Moisture was evaporated nearly completely, and all were able to be fabricated although the specific gravity for the No. 3 silicate of soda called for by said formula (Msn-Mt)/(Vx1000) manufactured 0.1, 0.5, and the foam set to 0.9. The result of having measured a foaming situation and the waterproof time by boil water immersion about these foam is shown in Table 5. Moreover, the result on which the specific gravity for the No. 3 silicate of soda which carried out 15 weight part addition of the way acid to the solid content 100 weight part of the above-mentioned No. 3 silicate of soda did the same fireproof examination as a work example 2 about the foam of 0.1 is shown in Table 6.

[0026]

[Table 5]

サンプルNo.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
比重	0.1	0.5	0.9	0.1	0.5	0.9	0.1	0.5	0.9	0.1	0.5	0.9	0.1	0.5	0.9
発泡倍率	25	5	3	25	5	3	25	5	3	25	5	3	25	5	3
ほう酸	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15
水酸化アルミ	7	7	7	10	10	10	35	35	35	50	50	50	100	100	100
発泡状況	良好	良好	良好	良好	良好	良好	良好	良好	良好	良好	良好	良好	良好	良好	良好
耐水時間	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60

サンプルNo.	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
比重	0.1	0.5	0.9	0.1	0.5	0.9	0.1	0.5	0.9	0.1	0.5	0.9	0.1	0.5	0.9
発泡倍率	25	5	3	25	5	3	25	5	3	25	5	3	25	5	3
ほう酸	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
水酸化アルミ	7	7	7	10	10	10	35	35	35	50	50	50	100	100	100
発泡状況	良好	良好	良好	良好	良好	良好	良好	良好	良好	良好	良好	良好	良好	良好	良好
耐水時間	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60

比重は3号珪酸ソーダ分の比重、耐水時間における60は60分以上であることを示す。

[0027]

[Table 6]

水酸化アルミ 添加量(重量部)	時間(分)						
	0	5	10	15	20	25	30
7	30	30	45	70	105	160	220
10	30	30	45	65	100	120	150
35	30	30	40	60	85	100	120
50	30	30	40	60	80	90	100
100	30	30	40	60	80	90	100

裏面温度(℃)

[0028] As a result, the sample which added the way acid had the good foaming situation, and it was changeless also in immersion of 1 hour about a water resisting property. Moreover, although any sample which added hydroxylation aluminum about fire resistance burned or it did not collapse, receive a No. 3 silicate-of-soda solid content 100 weight part. By the sample which more than 10 weight parts added compared with the sample which carried out 7 weight part addition of the hydroxylation aluminum, the temperature of the back of 30 minutes after fell, so that the loadings of hydroxylation aluminum was large.

[0029]

[Effect of the Invention] [ the production method of the core material for metal sandwich panels concerning this invention ] as explained in full detail above Not using an inorganic particle like perlite to which it foamed beforehand, what carried out specified quantity addition of a way acid and/or the hydroxylation aluminum as an additive is made No. 3 silicate of soda with a raw material. After considering it as the gel-like raw material evaporated until it heated agitating this beforehand and a moisture content became 70 - 80 weight part to the solid content 100 weight part of No. 3 silicate of soda, [ with heating ] While carrying out foaming hardening so that the specific gravity for No. 3 silicate of soda may be set to 0.1-0.9, it is the method of evaporating moisture nearly completely and using the whole as uniform and lightweight foam. The obtained core material for metal sandwich panels becomes a thing with sufficient hardness, a water resisting property, and/or fire resistance, and the industrial value is very big.

[Translation done.]